

# Integrating and Visualizing Tropical Cyclone Data Using the Real Time Mission Monitor



## 33<sup>rd</sup> International Symposium on Remote Sensing of the Environment

4-8 May 2009

UAH  
The University of Alabama in Huntsville

Michael Goodman, Richard Blakeslee  
NASA Marshall Space Flight Center  
Huntsville, Alabama

Helen Conover, John Hall, Yubin He, and Kathryn Regner  
University of Alabama in Huntsville  
Huntsville, Alabama

## Abstract

The Real Time Mission Monitor (RTMM) is a visualization and information system that fuses multiple Earth science data sources, to enable real time decision-making for airborne and ground validation experiments. Developed at the NASA Marshall Space Flight Center, RTMM is a situational awareness, decision-support system that integrates satellite imagery, radar, surface and airborne instrument data sets, model output parameters, lightning location observations, aircraft navigation data, soundings, and other applicable Earth science data sets. The integration and delivery of this information is made possible using data acquisition systems, network communication links, network server resources, and visualizations through the Google Earth virtual globe application.

RTMM is extremely valuable for optimizing individual Earth science airborne field experiments. Flight planners, scientists, and managers appreciate the contributions that RTMM makes to their flight projects. A broad spectrum of interdisciplinary scientists used RTMM during field campaigns including the hurricane-focused 2006 NASA African Monsoon Multidisciplinary Analyses (NAMMA), 2007 NOAA-NASA Aerosonde Hurricane Noel flight, 2007 Tropical Composition, Cloud, and Climate Coupling (TC4), plus a soil moisture (SMAP-VEX) and two arctic research experiments (ARCTAS) in 2008.

Improving and evolving RTMM is a continuous process. RTMM recently integrated the Waypoint Planning Tool, a Java-based application that enables aircraft mission scientists to easily develop a pre-mission flight plan through an interactive point-and-click interface. Individual flight legs are automatically calculated "on the fly". The resultant flight plan is then immediately posted to the Google Earth-based RTMM for interested scientists to view the planned flight track and subsequently compare it to the actual real time flight progress.

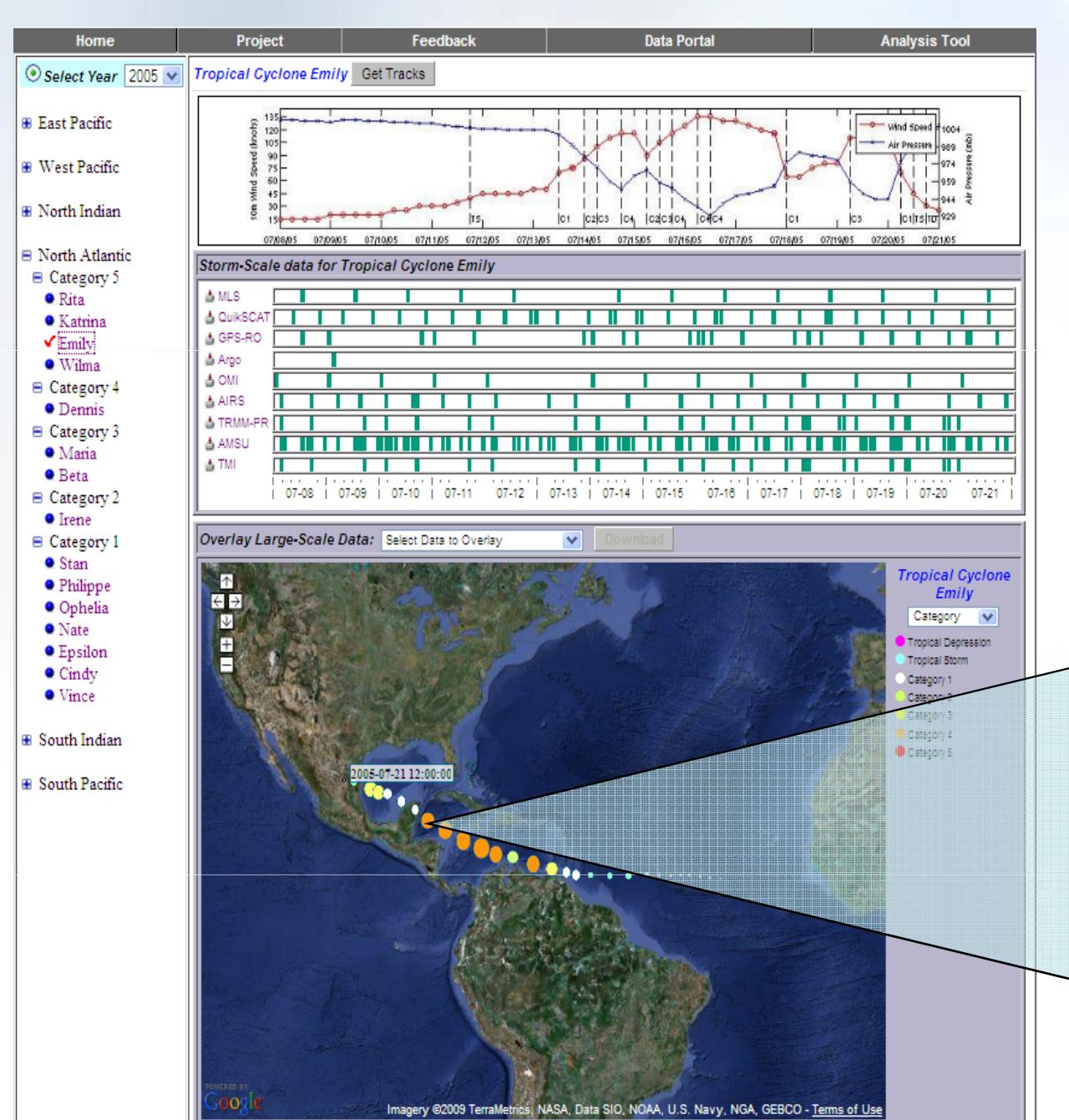
We are planning additional capabilities to RTMM including collaborations with the Jet Propulsion Laboratory in the joint development of a Tropical Cyclone Integrated Data Exchange and Analysis System (TC IDEAS) which will serve as a web portal for access to tropical cyclone data, visualizations and model output.

## Tropical Cyclone – Integrated Data Exchange and Analysis System

Joint NASA Jet Propulsion Lab and Marshall Space Flight Center Project

Objective: To provide fusion of multi-parameter hurricane observations (satellite, airborne and *in-situ*) and model simulations with the purpose of:

- supporting both research and field campaigns (incorporating RTMM)
- understanding the physical processes
- improving hurricane forecast by facilitating model validation and data assimilation
- enabling the development of new algorithms, sensors and missions.

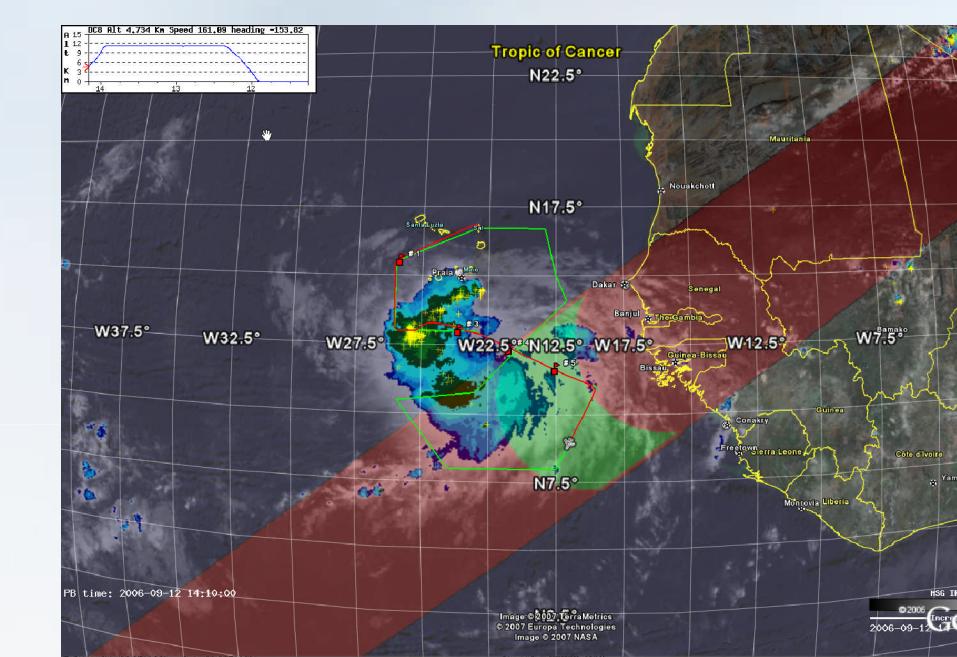


ER2/AMPR passive microwave over flight of H. Emily during the 2005 TCSP field experiment

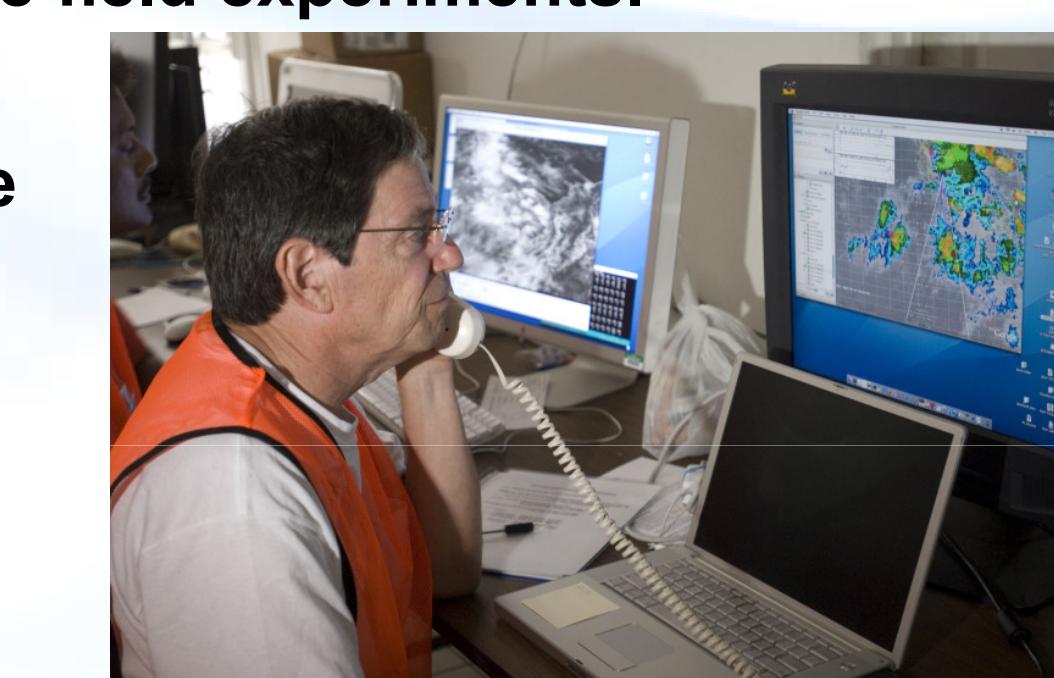
Integrate NASA Airborne field data sets with satellite data

## "Making Science Easier"

The Real Time Mission Monitor (RTMM) is an interactive visualization application that provides situational awareness and field asset management to enable adaptive and strategic decision making during airborne field experiments.



- Integrates satellite, airborne, and surface data sets
- Tracks airborne vehicle state information
- Displays model and forecast parameters



Dave Starr, Lead Mission Scientist uses RTMM from the TC4 Operations Center



### RTMM enables

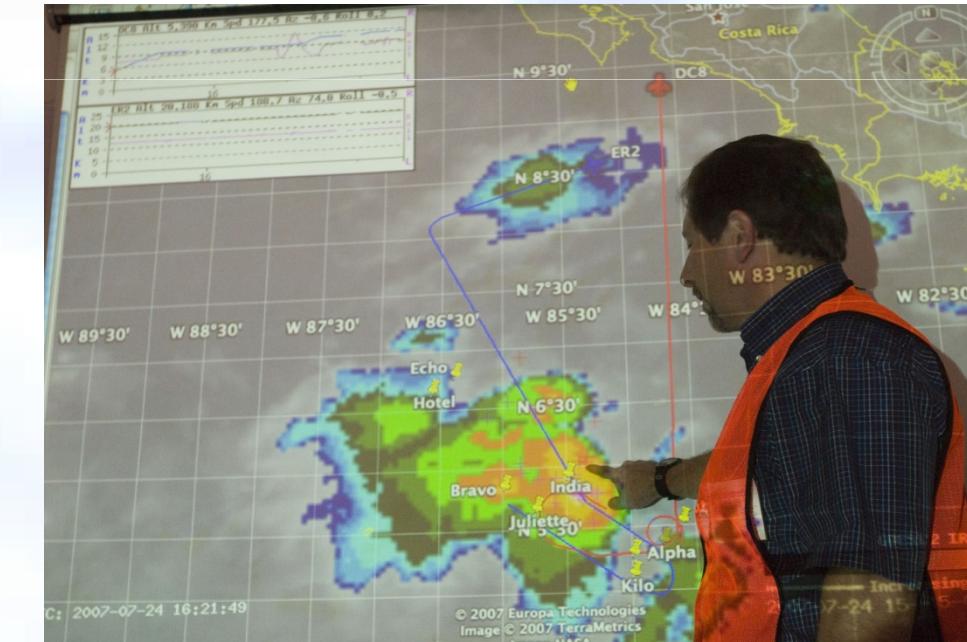
- Real time interactions & collaborations
- Post-flight mission review and case study development

Paraphrasing the BASF television commercial:  
"We don't make the science, we make the science easier"

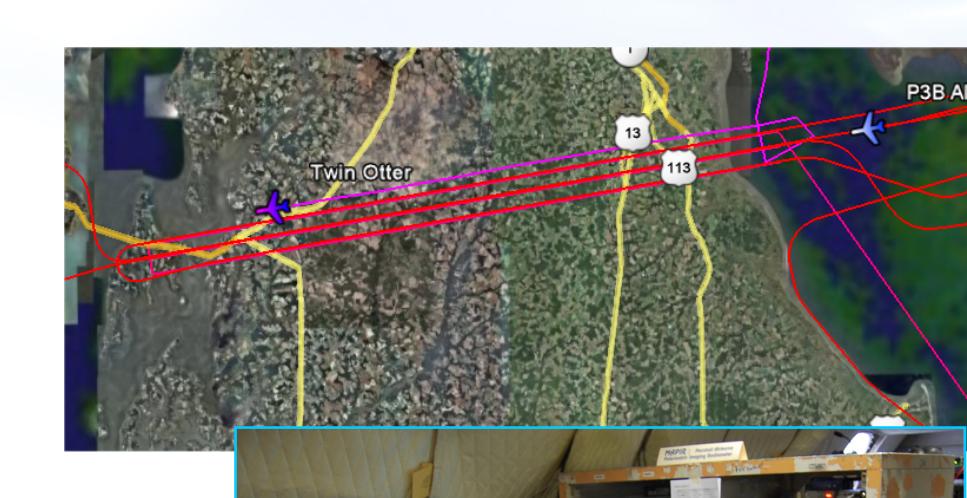
## Planning, Support, and Analysis

RTMM is useful in all three phases of field experiment. RTMM facilitates:

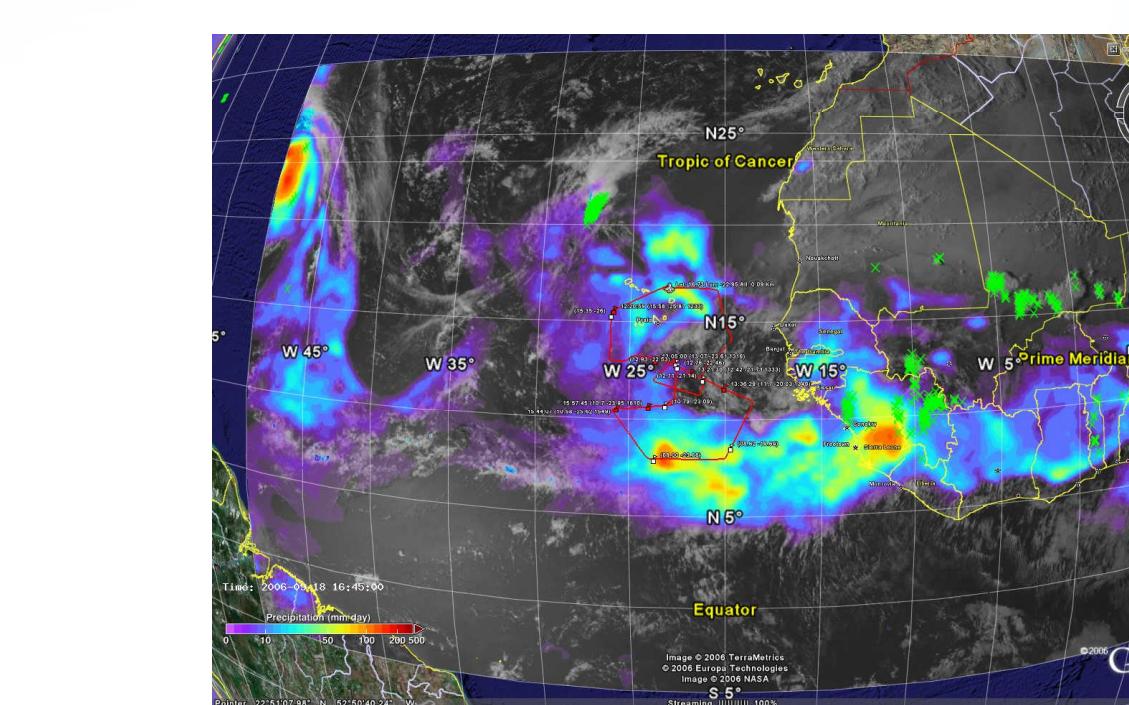
1. Pre-flight planning
  - Interactive waypoint tool
  - Satellite overpass predicts
2. In-flight monitoring and adaptive flight strategies
  - Operations center focal point
  - Current weather conditions
  - Plane-to-plane data transfer
3. Post-flight analyses, research, and assessments
  - Encapsulate and replay missions



Monitoring the flights on the "big screen" during TC4

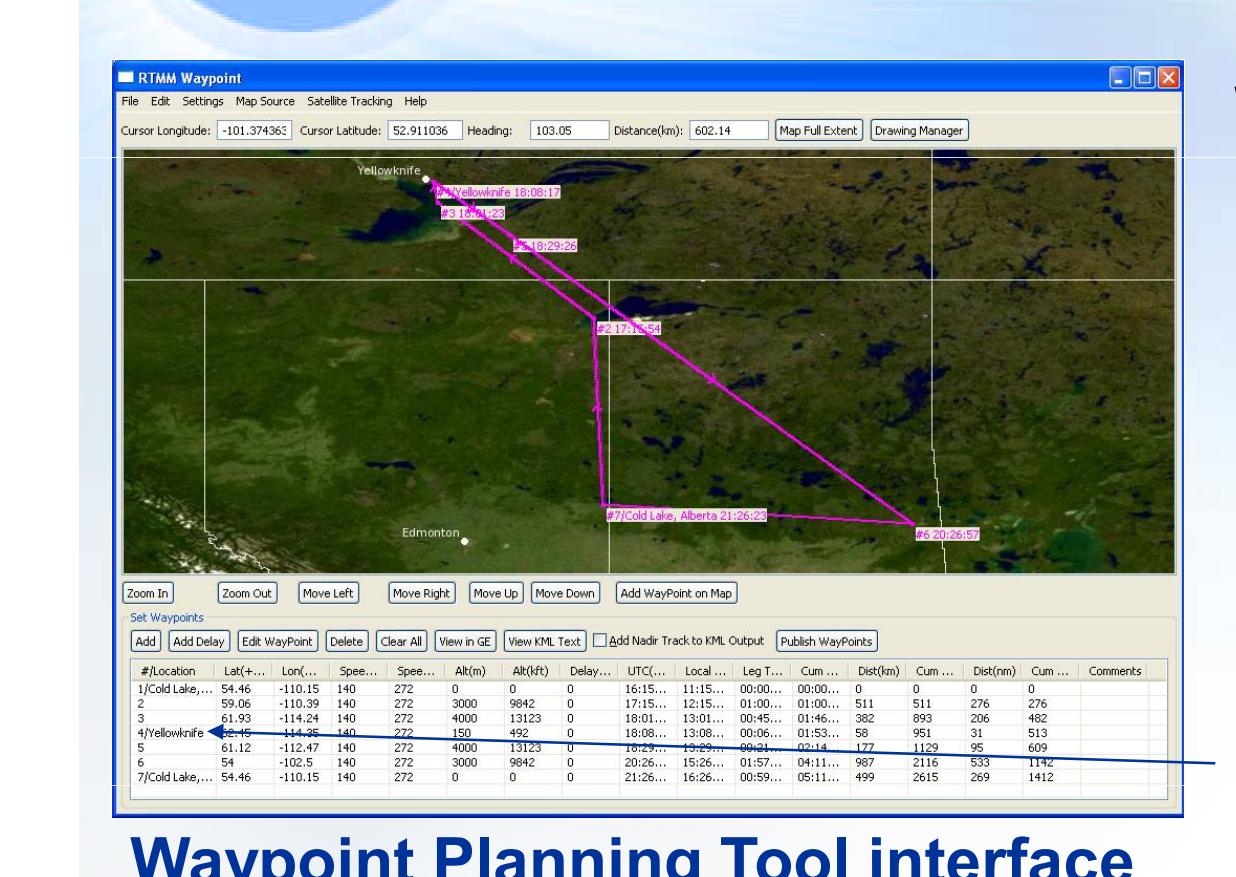


Chip Laymon uses RTMM aboard the P-3 during SMAP VEX 2008

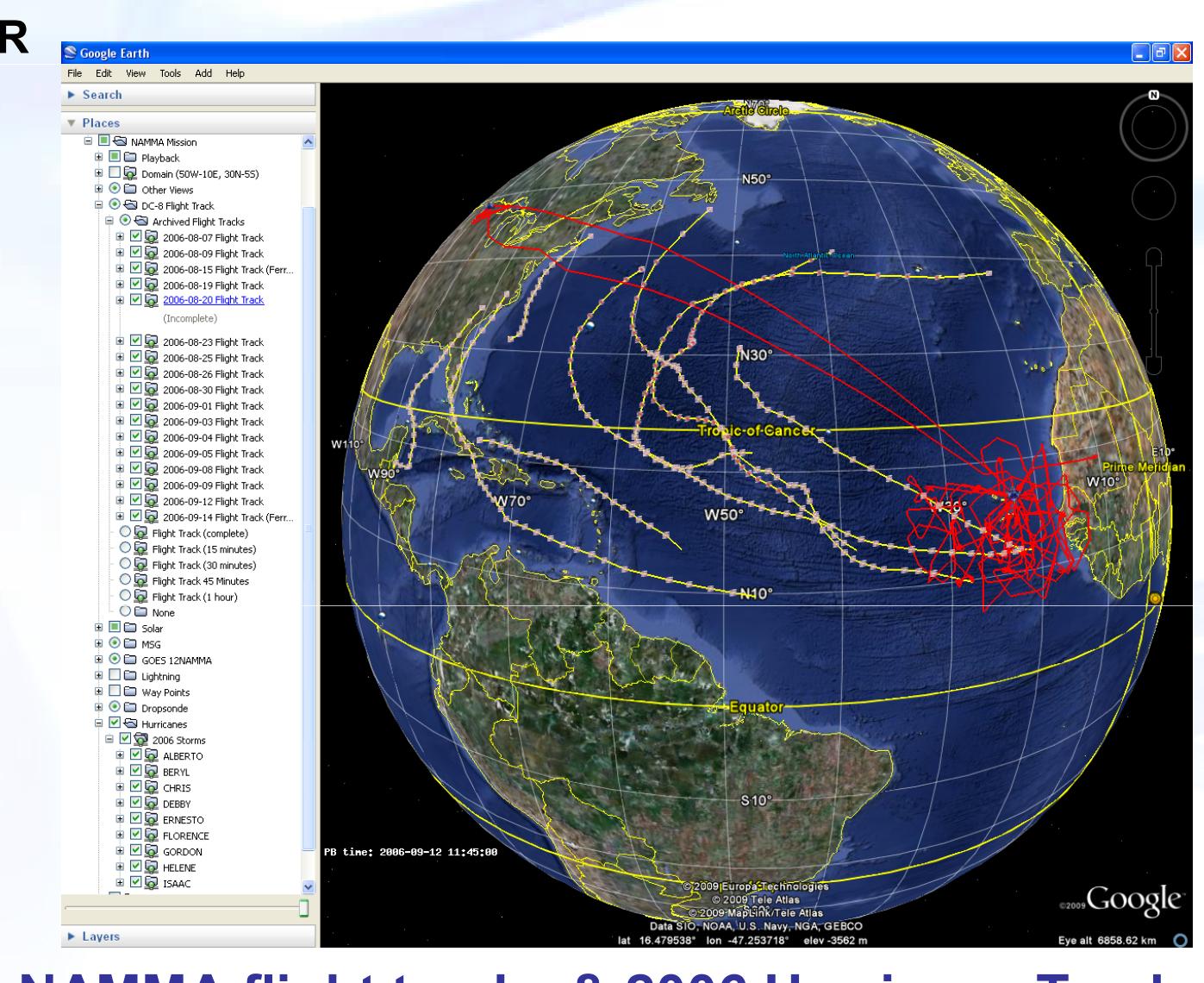


Overlay forecast parameters

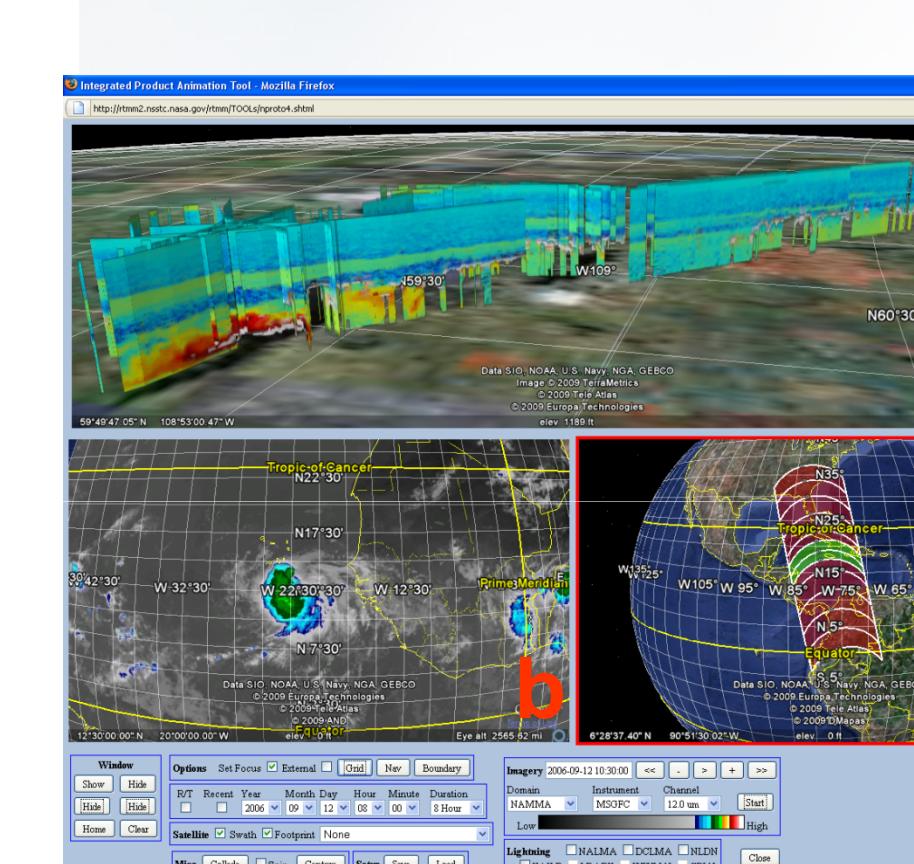
## New Tools and Directions



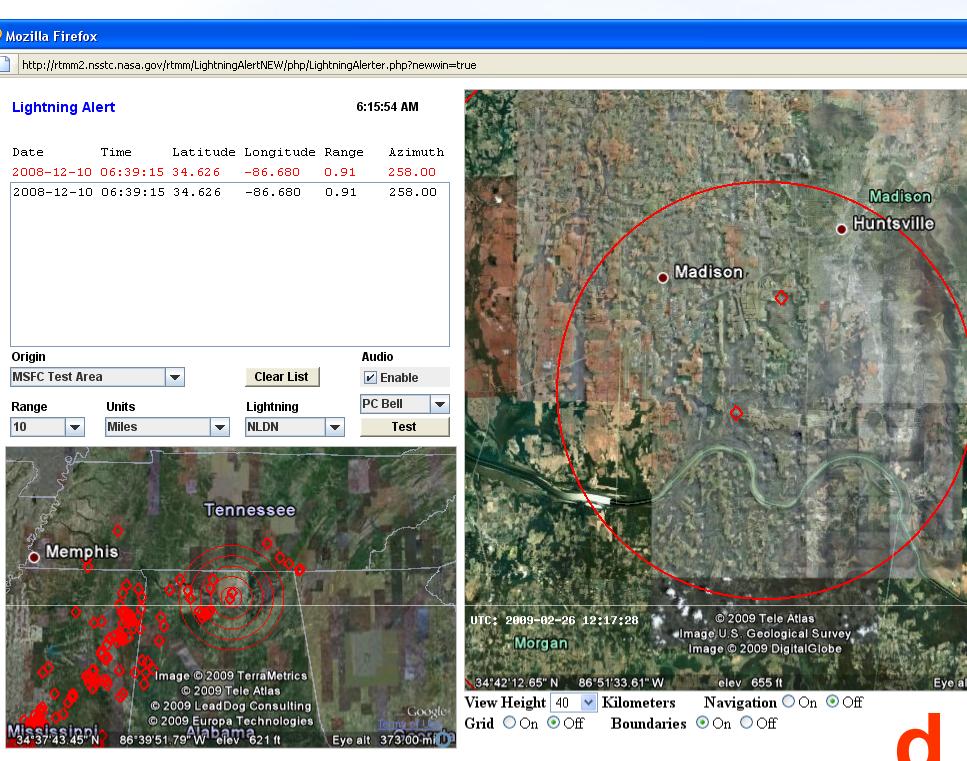
Waypoint Planning Tool interface



Incorporate historical archived tropical cyclone database into RTMM



New web browser plug-in application provides greater flexibility and expands the capability to open multiple RTMM windows.  
a) Lidar curtain plot  
b) Real time animated hurricane imagery  
c) Satellite tracking – real time and predictive  
d) Lightning alert – real time and historical



d

## In Cooperation With:

- Larry Freudinger – NASA Dryden Global Test Range
- NASA Ames Earth Science Project Office (ESPO)
- Svetla Hristova-Veleva – Jet Propulsion Laboratory
- The many airborne and instrument scientists from CAMEX, TCSP, NAMMA, TC4, Aerosonde Demonstration, ARCTAS & SMAP-VEX field campaigns

## Acknowledgments:

Support provided by NASA Science Mission Directorate:

- Ramesh Kakar – Weather Focus Program Manager
- Hal Maring – Radiation Science Program Manager
- Jim Crawford – Tropospheric Chemistry Program Manager
- Andrew Roberts – Airborne Science Program Manager
- George Komar – Earth Science Technology Office Manager

## More Information:

To view animations and replays of individual flights, please go to the RTMM web site at:  
<http://rtmm.nsfc.nasa.gov>

## Author Contact:

Michael Goodman  
NASA/MSFC Earth Science Office  
➤ [michael.goodman@nasa.gov](mailto:michael.goodman@nasa.gov)  
➤ Office phone: 256 961 7890